Volume 29 August, 1943 *Number 8*

Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

Lubrication of Oil-Field Machinery

PUBLISHED BY
THE TEXAS COMPANY
TEXACO PETROLEUM PRODUCTS

TEXACO LUBRICANTS IN THE OIL FIELDS

DRILLING MACHINERY

DRAW WORKS

BEARINGS—Sleeve Type—Oil	Texaco Aleph or Altair Oils
Sleeve Type—Grease	Texaco Marfak or Texaco Cup Grease
Anti-friction	Texaco Marfak No. 0 or No. 1
GEARS AND CHAINS	
Enclosed (above 60° F.)	Texaco Ursa or Texol F
Enclosed (below 60° F.)	Texaco Algol or Texol E
CABLES, Exposed Gears and Mild Steel Chains	Texaco Crater No. 00 or No. 1
TEMPERED STEEL CHAINS	Texaco Alcaid, Aleph or Altair Oils
CROWN AND TRAVELING BLOCKS	Texaco Marfak
SWIVEL THRUST	Texaco Meropa Lubricant 4, 5 or 6
PACKING LUBRICATION	Texaco Water Pump Grease

ROTARY MACHINES

TABLE BEARINGS	
Sleeve Type—Grease Lubricated	Texaco Marfak or Texaco Cup Grease
Oil Lubricated	Texaco Aleph or Altair Oils
ANTI-FRICTION BEARINGS	
Grease Lubricated	Texaco Marfak
Oil Lubricated	Texaco Algol or Ursa Oils
EXPOSED GEARS	Texaco Crater 1, 1-X or 2-X
ENCLOSED GEARS	Texaco Thuban 140

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DRILL PIPE THREADS AND CASING THREADS	Texaco Drill Stem Lubricant Texaco Axle Grease Graphite Texaco Pipe Thread Lubricant Texaco Vega Grease No. 0
DRILL BITS	
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High Temperatures	Texaco Crater 1, 2, 1-X or 2-X

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(Continued on Inside Back Cover)

LUBRICATION

A TECHNICAL PUBLICATION DEVOTED TO THE SELECTION AND USE OF LUBRICANTS

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Lubrication of Oil-Field Machinery

BUILDERS of oil-producing machinery can testify to the value of effective lubrication. They have observed the benefits, the degree to which the life of machine parts is lengthened, the reduction in maintenance costs. The results of their experience are reflected in the care with which they design oil-field machinery for lubrication.

The layman visualizes an assembly of oil well drilling or pumping machinery according to the most obvious elements — the derricks. Derricks signify power and typify the magnitude of the petroleum industry. Their function in oil well drilling is the supporting of the crown blocks over which the steel drilling cables are run so that the casing and drilling pipe may be raised and lowered in the well. Access to the bearings of the crown block sheaves is provided by ladders, thereby facilitating lubrication of these important parts.

But other machinery is quite as important; the engines for power generation, the chains for power transmission, the pumps for mud circulation and the draw works for drilling. We suggest study of the illustrations which accompany this article. They pertain especially to lubrication.

SINCE the days when kerosine was the most important product of crude petroleum, power has been the controlling factor in oil-field production. From the time the rig starts to drill until the pool is exhausted or pumping no longer is economical, power is necessary to operate the attendant machinery.

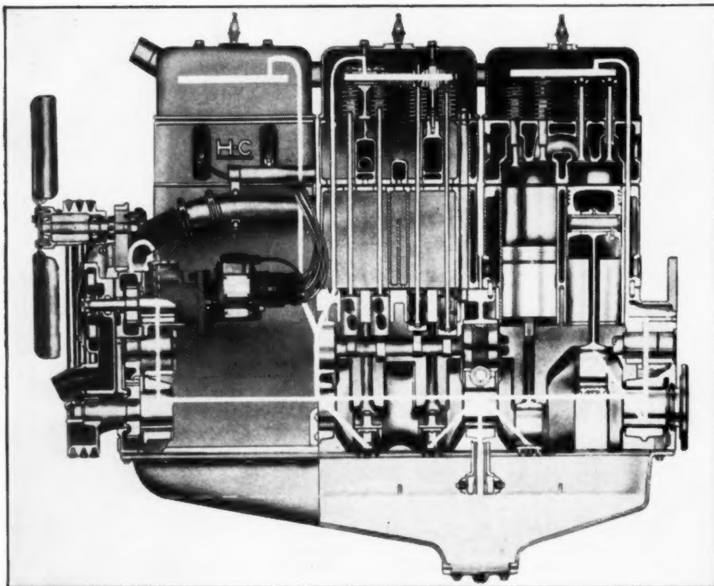
Steam power has been widely utilized ever since petroleum became an industry, for the oil itself could be burned to generate the steam required for all other machinery. In later years, steam, however, has given way to some extent to the Diesel or gas engine; but here again the oil itself is the basic source of power. It is just consumed and converted to mechanical energy in a different form of combustion chamber.

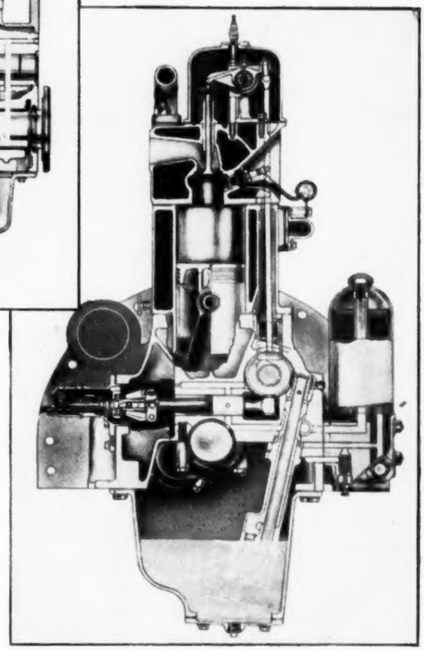
In many ways oil-field engines are similar to those designed for industrial service. As far as theory goes, they are identical; also they look very much the same. But the severity of the operating conditions and exposure to the elements renders maintenance usually more of a difficult procedure.

Quite naturally, these operating conditions impose a heavy load upon lubrication and engine lubricants. It means that these latter must work under overload much of the time. In steam pump and engine service the nature of the steam is the criterion. In the Diesel or gas engine fluctuations in atmospheric temperatures, high dust-content in the air, and possible difficulty in engine cooling must be considered.

DESIGNING FOR STEAM

Steam driven engines, pumps and compressors for oil-field service have always embodied simplicity in design. Builders and operators alike have taken into consideration that very often the moisture content of the steam may be higher than in any other type of service, for the steam is utilized under adverse conditions most of the time. Quite naturally, exposure of the entire power plant is the primary cause. Oil-field boilers and engines are seldom sufficiently housed to enable even limited control of room temperatures as is usual practice in an indus-





Courtesy of Minneapolis-Moline Power Implement Company.

Fig. 1—Details of the M-M oil field engine showing end and side view details of the oiling system and method of circulation.

trial plant. Furthermore, high steam pressures usually are not necessary — from 100 to 350 pounds gauge is a fair average. So we have conditions of steam cylinder lubrication which only can be met with a highly compounded cylinder oil. Furthermore, this must be a rugged oil which will form a film capable of resisting the wearing effect of foreign matter. The water available for steam boilers in many oil-field areas is relatively hard, often containing suspended sediment. Foreign matter of this nature is abrasive and if carried over to the engines with the steam, it can cause abnormal wear of the cylinder walls and valve surfaces unless they are protected by a tough durable film of emulsifiable steam cylinder oil.

Type of Engine

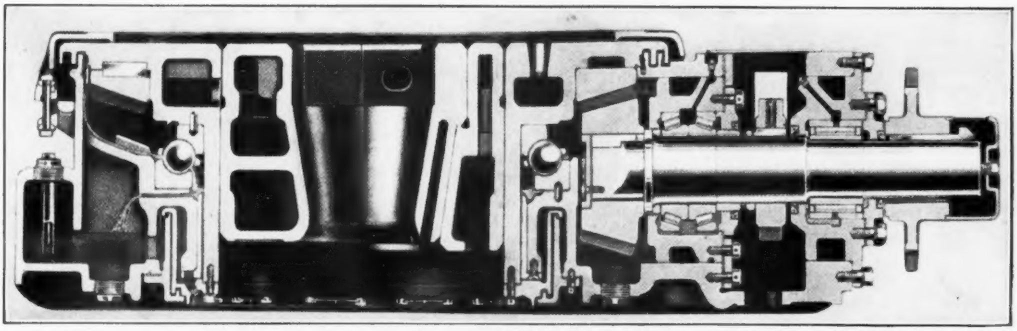
The horizontal two-cylinder engine equipped with a slide or piston valve is usually the most dependable machine under these conditions. This type of steam unit is particularly applicable for furnishing power to the draw works and pumps through a sprocket or chain drive. This rugged type of engine can turn out power almost regardless of the operating conditions.

But the foresighted oil-field operator does not let these conditions get too severe. The engine builders provide for this by designing so that the crankcase and external parts are entirely enclosed. This permits of bath or splash lubrication; it also prevents unwarranted entry of mud, rain, dust or other non-lubricating foreign matter. In such an engine the connecting rod bearings and other external parts can be amply lubricated by a good 300 to 500 viscosity engine oil according to the atmospheric conditions. Naturally, in the northern or western oil fields a lighter oil is advisable, especially in winter when the question of fluidity of the crankcase oil is important.

Valve and cylinder lubrication in turn is accomplished by hydrostatic or mechanical force feed lubricators with suitable leads to the steam line or intake manifold at the steam chest.

Line condensation is reduced by careful insulation of all steam piping and exposed boiler and engine parts. This insulation must be properly maintained to be most effective. Steam chest temperatures are, of course, influenced by the boiler pressure. The higher the latter, the higher will be the temperature. In addition, super-heating, if applied, will increase the steam temperature that much higher.

It is not difficult to maintain proper engine cylinder lubrication under high steam temperatures. But when high temperatures are accompanied by moisture developed through line condensation or priming, lubrication becomes more difficult. Hence the advisability of reducing condensation as much as



Courtesy of Oil Well Supply Company, United States Steel Corp. Subsidiary.

Fig. 2—Lubricating system of the "Oilwell" rotary which involves continuously circulating oil-bath lubrication of the gear and pinion teeth and the radial ball bearings. The pinion shaft rollers in their sealed enclosures are separately lubricated.

possible. Normally a compounded steam cylinder oil will meet these conditions most effectively, the amount of compound or fixed (fatty) oil being dependent upon the amount of moisture in the steam.

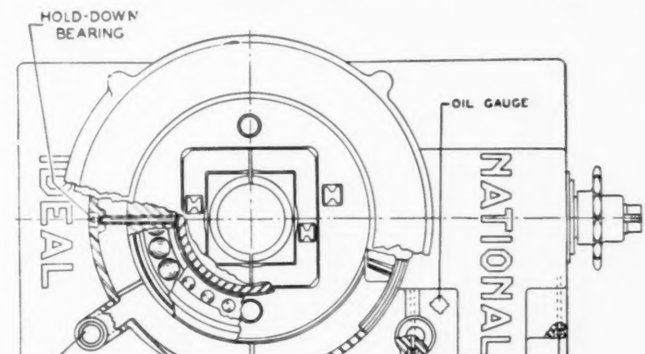
For the more usual condition of comparatively wet steam a medium viscosity cylinder stock compounded with around six to eight per cent of fatty oil will function effectively.

Condensing engines are seldom used in the oil-fields, so normally the operator does not worry about presence of cylinder oil in the exhaust. Accordingly, a certain excess of cylinder oil can be fed to the engine; unless very high temperature steam is used. This may be good practice to assure maximum protection of cylinder liners, for in the horizontal engine one must remember that the lower part of the liner is under considerable pressure due to the dead weight of the piston. An excessive oil feed, however, may result in carbon deposits. Cylinder liner wear is not as serious in the vertical, twin-cylinder steam engine when applied to oil-field service.

Steam cylinder lubrication in the vertical type engine will differ but little, otherwise, from that of a horizontal engine. The primary purpose is to use an oil containing sufficient compound to lather readily with the moisture content of the steam, and of sufficient viscosity to meet the prevailing temperature conditions. Any such oil will be comparatively heavy in body, and hence may flow with difficulty in cold weather. Where winter-time temperatures may not be extreme as in the Gulf Coast area or California, the question of fluidity is not a problem. In the central west or Pennsylvania fields, however, one must usually study methods of lubricator protection to insure against congealment of the oil at low temperatures for this might easily decrease the amount of oil delivered to the cylinders, or even prevent flow entirely. To offset this, mechanical force feed lubricators, equipped with heating coils in the oil reservoirs should be used.

DIESELS AND GAS ENGINES

The oil-field Diesel and gas engine has been widely adopted during recent years. The trend towards Diesel power accompanied the extension of pipe line facilities and the necessity for self-



Courtesy of The National Supply Co.

Fig. 3—Sectional views (top and side) of the "Ideal" rotary drilling machine showing certain of the lubrication details. The main bearing operates in a bath of oil, circulation being induced by rotation of the table. The pinion, in turn, picks up oil from another reservoir to supply it to the gears. The hold-down and pinion shaft bearings are pressure grease lubricated.

Courtesy of Emsco Derrick and Equipment Company

Fig. 4—Top and side views of an Emsco rotary machine. Large oil reservoirs enable ample oil pick-up by the pinion to serve the ring gear and oil splash pans which direct a stream of oil to the main bearing. The pinion shaft bearings are grease lubricated.

powered pumping units. The gas engine quite naturally proved its value as a medium for utilizing the natural gas which not so many years ago was regarded as a necessary evil. The gas engine is perhaps the more flexible in application because it can burn practically any type of natural or refinery gas. Certain designs also can be readily converted to burn distillate oils or gasoline. The Diesel, on the other hand, functions best on a heavier distillate fuel or high grade crude oil.

Either type of engine can be designed to operate horizontally or vertically at comparatively low speed, but developing high power output in proportion to the speed.

The internal combustion engine in oil-field service may have to function at any time under adverse conditions depending on the geographical location. Needless to say, summer operation in the South or Southwest may involve atmospheric temperatures well over 100° F. with very sharp drops (of 30 to 50 degrees) at night. In some localities the atmospheric dust content may be very high. Furthermore the burning of natural or casinghead gas presents another condition which is entirely foreign to other types of internal combustion engine fuels: entrained air.

Air in casinghead gas is one of the greatest sources of trouble in the operation of a gas engine, due to the detrimental effect on cylinder lubrication. Air in such gas usually results from defective casingheads which permit air leakage in variable amounts into the lines due to the vacuum which is drawn on the wells. Gas engines operating on air-contaminated fuel are subject to excessive air which causes pre-ignition and overheating. This can become so severe as to destroy the lubricating film on the cylinder walls.

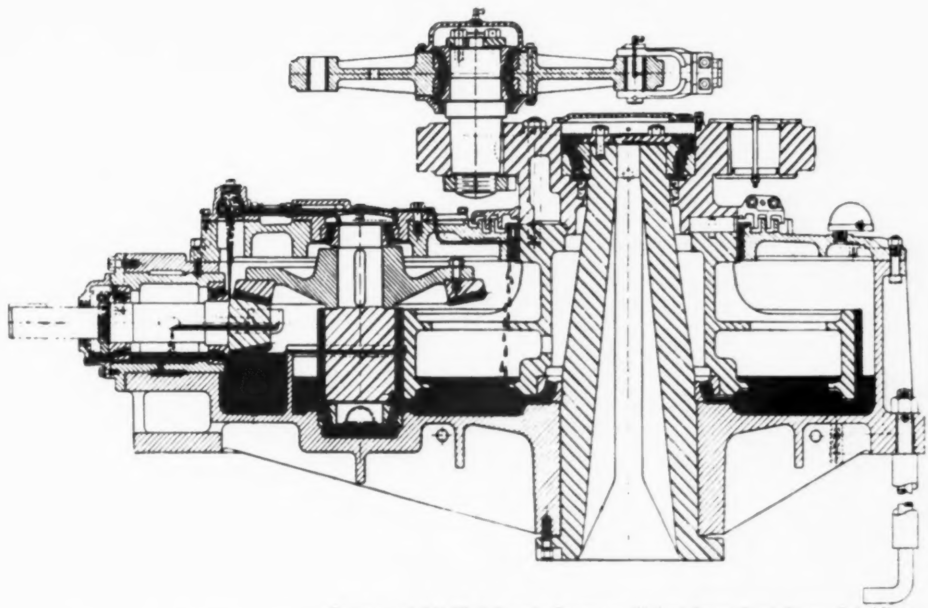
Effect of Contaminated Cooling Water

Another frequent cause of difficulty in the operation of oil-field Diesel and gas engines is unsuitable cooling water. In some areas, the water available may be very hard and have a tendency to deposit scale and form an insulating coating in the water jackets. This will result in insufficient cooling, and when it develops in an engine already subjected to abnormally high operating temperatures, it may become another cause of pre-ignition, back-firing, sludging, high oil temperatures, stuck rings and destruction of the lubricating film on the cylinder walls.

Adequate cooling is most essential in the interest of maintenance of positive lubrication. The prevention of deposits can be assisted by using treated water whenever possible.

Engine Deposits

Formation of deposits in the combustion chamber of the gas engine occurs in much the same manner as in the Diesel. There will be but little possibility, however, of this being aggravated by the type of gas used unless the gas is dirty or has a high dust content, when the same results would occur as when liquid fuel is subjected to incomplete combustion, i.e., fouling and sticking of the valves, and possibly increased cylinder wear due to abrasion and stuck piston rings. Then an undue load is imposed upon the lubricating oil under conditions which, in turn,



Courtesy of Oil Well Supply Company, United States Steel Corp., Subsidiary
Fig. 5—The lubricating system of the "Oil Well" single-crank Geared Power. Solid black represents the oil bath. Lighter black (above) indicates grease lubricated bearings.

may cause it to break down, with subsequent damage to the bearings.

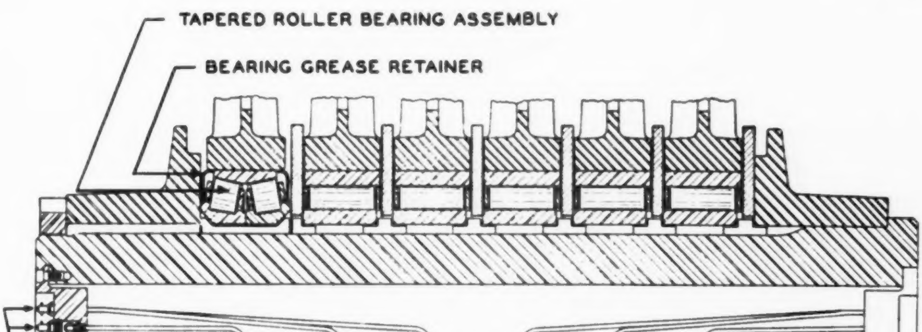
UTILIZATION OF POWER

The oil field engine functions primarily to transmit power to the drilling rig, i.e., the hoist and draw works; to operate the slush or mud pumps; to operate the oil well pumps which deliver the oil to the surface; and later the pumping units in pipe line service.

The methods of drilling are of interest. According to the types of tools employed drilling is done by percussion (cable tool) or rotary methods. Derricks are required for both as well as for any of the recent modifications or combinations of these systems.

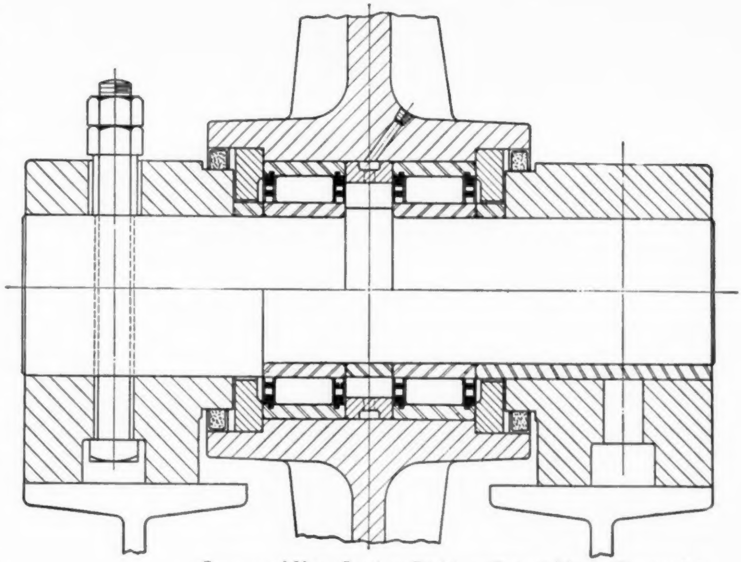
Cable-Tool Drilling

Cable drilling originated in the early development of the oil industry where the fields involved hard dry strata such as shales, limestones and carboniferous rock formations. It was also found to be well adapted to shallow well drilling, a fact which led to the use of the less-costly portable unit for drilling test holes. In cable drilling a bit or heavy,



Courtesy of The National Supply Company.
Fig. 6—The "Ideal" crown block showing details of the roller bearing assemblies and relative location of the means for pressure grease lubrication.

sharpened tool is periodically driven against the strata to be drilled, to break or crush its way through by impact. The cuttings or crushed materials are removed by means of a bailer or long tube which is periodically lowered into the hole. In this type of percussion drilling, power is transmitted directly from the engine to the band wheel, which operates the walking beam. The shaft of this wheel is mounted on sleeve bearings, with two chain sprockets and a rope sheave on one end and a crank on the other. This crank drives the walking beam which operates the drill bit through a wood connecting rod known as the pitman. One of the above mentioned chain sprockets in turn drives the sand reel for the bailer, the other operating the calf wheel which is used to handle the pipe or casing. The rope sheave drives the bull wheel which is used to raise or lower the drill bit. Babbitt is widely used as the bearing metal for the shafting of the above mentioned parts.



Courtesy of Hyatt Bearings Division—General Motors Corporation.

Fig. 7—A crown block cable sheave showing manner of installing Hyatt roller bearings.

Since the speed of the bull wheel controls the speed at which the tools are let into the hole, a band brake is used to regulate the speed of the wheel. This brake is usually a steel band with provision for water-cooling to prevent overheating during rapid running of the heavy tools in the hole. This spray of water imposes another requirement on the lubricants used on certain of the adjacent bearings, in that they must resist any washing action due to contact with water.

Rotary Drilling

Rotary drilling is preferred when dealing with soft, damp or relatively wet rock formations, which cave in readily, or in localities where ample water and fuel are available; it has now practically superseded the cable tool method. Rotary drilling is carried out by rotation of the bit which is attached to the drill pipe. This latter is heavier than ordinary well casing, resistant to twisting, and capable of withstanding high pressures and impact loading. No bailing mechanism is necessary in this type of drilling.

Rotary drilling is usually carried out in the presence of watery mud or slush. This latter serves not only to facilitate the cooling of the auger-like edge of the bit during drilling, but also it washes out the cut materials and holds back the water or hydrocarbons in the formations being penetrated. To bring this about the mud is pumped down the hollow drill pipe; through perforations in the end of the bit and back to the surface through the space outside between the pipe and wall of the hole.

The Draw Works in Rotary Drilling

The hoist or winch mechanism which is used in rotary drilling is termed the draw works. Normally it involves a sprocket and chain connection from the main engine to the line or drive shaft. On this shaft are three chain sprockets, one connected to the engine, as stated, one to the rotary table and the third to the jack shaft. Chain drives serve as the connections in all cases.

The hoisting drum or spooling reel is equipped with a clutch and high and low speed sprockets driven from the jack shaft. This drum handles the steel wire cables essential to drilling operations between the crown and travelling blocks, and at this point carries the entire weight of the tool string and casing materials.

In modern drilling, loads may be severe, units being designed today to handle safely upward of 350 tons working load. These loads will react upon shaft bearings and chain connections. For this reason roller bearings are now widely used on modern oil field drilling equipment. They can be lubricated by either oil or grease according to the housing and manner of sealing. A 300 to 500 second viscosity mineral oil functions satisfactorily in an oil-tight housing. Whenever there is possibility of leakage, however, the bearings can be equipped with pressure gun fittings and lubricated with a high quality pressure-resisting grease.

How the Rotary Method Operates

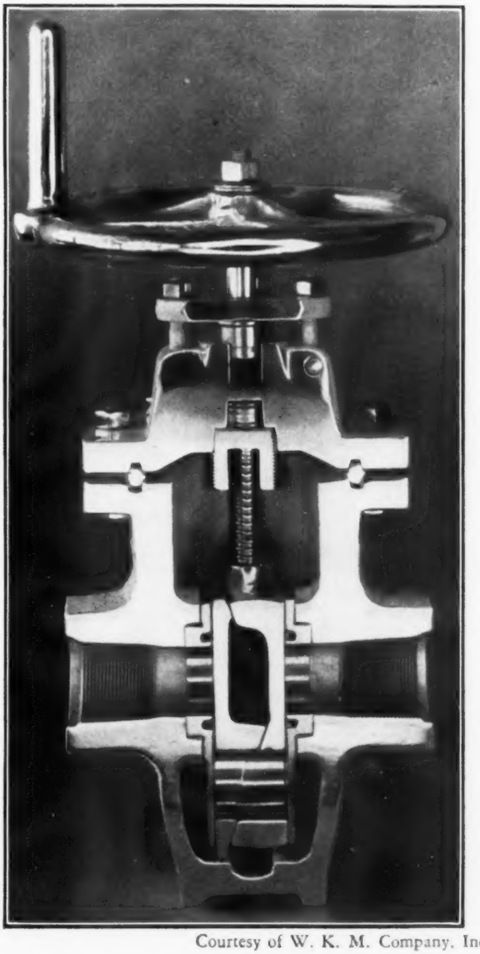
The rotary drilling machine is operated through a power take-off chain from the draw works. The

principle involved in turning the drill pipe is much the same as that employed in the rear axle and differential assembly in automotive service. This is accomplished by a bevel pinion and ring gear drive, located on a sturdy foundation at the level of the derrick floor.

The weight or thrust of the rotary table is usually carried on ball or roller bearings lubricated from an oil reservoir around the lower race; similar bearings may also be used to carry the pinion shaft.

Gears Function Best when Housed

Lubrication of gears and pinions and their respective bearings depends upon the installation and type of housing. Where gears are exposed and subjected perhaps to water and dust, a comparatively heavy gear lubricant of from 1000 to 2000 seconds Saybolt viscosity at 210 degrees Fahr., should be applied periodically to the tooth surfaces.



Courtesy of W. K. M. Company, Inc.

Fig. 8—The W-K-M, lubricated gate valve. By use of a specially prepared, heavy duty grease the working parts are well protected against corrosion, and friction is reduced to a minimum. With each opening or closing the gate is drawn into the upper or lower cavity where it is surrounded by lubricant. This latter can be renewed through the plug in the bottom.

Some designers prefer to house the table bearings, gears and pinions in a unit casing, the bottom of the table forming the oil reservoir. Under such conditions the one lubricant can be used for all elements, being circulated by the gear teeth or pump. The choice of lubricant must be contingent upon the tightness of the housing; usually a heavy automotive gear lubricant will function satisfactorily, although some will prefer a heavy motor oil of around the S.A.E. 60 range.

Blocks and Swivels

Other equipment incident to rotary drilling include the crown block, travelling block and swivel. All must be properly lubricated in order to assure of dependable operation.

The crown block is anchored securely at the top of the derrick. With its companion travelling block, it carries the steel cable attached to the hoisting drum on the draw works. Each block carries a number of sheaves over which this cable is passed in conventional pulley-block arrangement to give the necessary lifting power. As a result the crown block carries the entire weight of the tool string.

As crown and travelling blocks should be completely interchangeable they are mounted on bearings of similar type. Either bronze-bushed sleeve type bearings or roller bearings can be employed. Grease lubrication at regular intervals by pressure gun is preferable using a pressure-resisting-grease containing an oil of comparatively high viscosity.

The Swivel

The swivel, which enables free rotation of the drill pipe, is located below the travelling block, being suspended from the casing hook by a bail or hoop. On the under side is attached the drill pipe which rotates when operated. The entire weight of the tool string is therefore carried in turn by the swivel thrust bearings; so obviously the latter must be most carefully lubricated to prevent undue wear. The prevailing loads will increase in proportion to the depth of the well.

It is through the swivel that the slush fluid is admitted to flush cuttings from the hole and enable free rotation of the drill. Suitable piping and connections are installed to admit this fluid at the top and to direct it downward through the drill pipe.

The loads which prevail require a ball or roller type of swivel thrust, equipped with an oil reservoir of from ten to twenty gallons capacity. According to the size of the swivel, oil is circulated by the rotation of the bearing elements or by means of a pump. To meet the prevailing loads considerable body or viscosity is essential, the range normally being from 160 to 200 seconds Saybolt Universal at 210 degrees Fahr.; oils within the lighter range are suitable to smaller units. Highly refined automotive grade lubricants are best adapted to swivel thrust lubrication.

CHAINS AND SPROCKETS

Chain drives and sprockets serve as the power take-off from the oil-field steam engine. Where the gas or Diesel engine is used, however, a gear case or transmission is an added necessity, connected to the draw works through a Vee-belt or chain drive.

Drive chains of the roller type were used in the early development of cable tool drilling. When rotary drilling came in, chain design was given renewed attention. Improved types of roller mechanisms resulted, heat treated alloy steels of high breaking strength were used, and later the silent type of chain became applicable.

Throughout this development and application of chain designs to oil field equipment the builders had to consider load conditions. As strength and durability have increased so has the demand for more positive lubrication. The rugged nature of the roller chain, particularly where built with specially designed pins and bushings, proved it to be especially adapted to such conditions. By improving surface finishes the builders also improved lubrication by creating a design more capable of retaining lubricant.

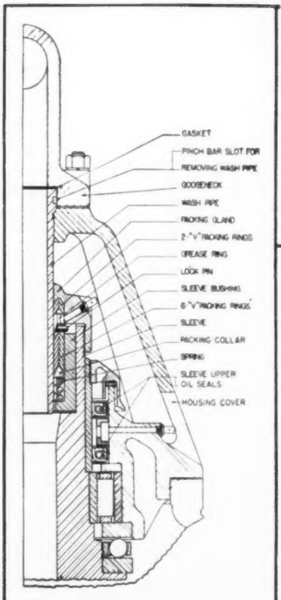
Silent chains are well adapted to the variety of intricate power transmission work involved in the oil fields. Where properly lubricated they will also develop but little wear. Usually they are provided with suitable housings and means for automatic circulation of lubricant, as a result cleanliness is maintained.

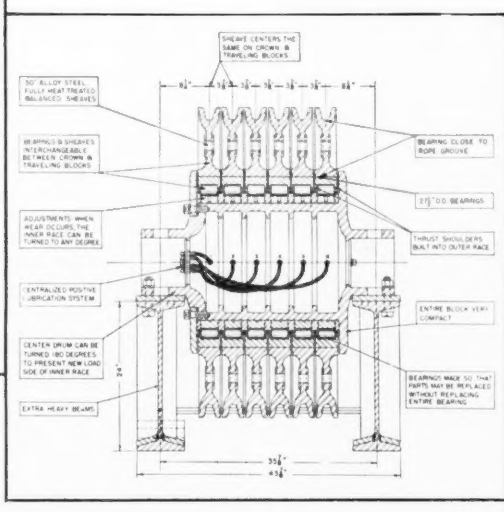
Lubrication Requirements

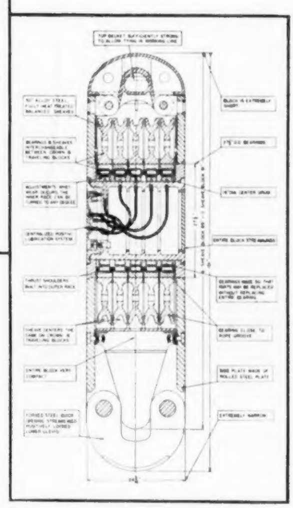
Effective lubrication of any oil-field driving chain installation requires that the operating conditions be carefully considered. These include the load, speed, clearances and the extent to which bending or articulation may occur. Each will have a direct bearing upon the ultimate performance which can be expected from the lubricant. Wherever chains can be housed in oil-tight casings, the problem becomes materially simplified, for contamination of lubricant is prevented and lighter bodied products can be used.

Load is a serious factor wherever a chain may be subjected to sudden starting or stopping. This causes severe shock on the chain parts. A lubricant of sufficient body (within the limits of its ability to penetrate) will serve as a buffer or shock absorber within the clearance spaces.

Speed in turn must be considered since it involves the frequency at which shocks may occur when the chain links engage with the teeth of the sprockets. Obviously, as speeds increase the shocks on each chain link will be more frequent. This will impose a more severe load on the film of lubricant on the contact surfaces which may lead to actual rup-

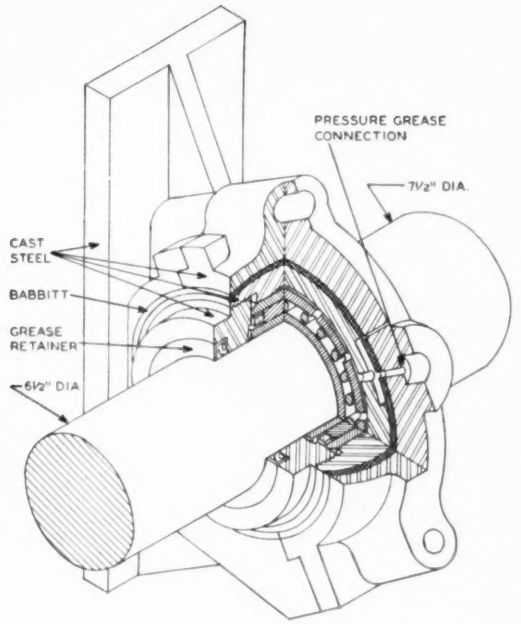






Courtesy of Emsco Derrick & Equipment Company.

Fig. 9—Details of the Emsco type G & F rotary swivel (left); a crown block (center); and a traveling block (right); for deep well drilling, showing in particular the provisions for pressure grease lubrication and the constructional features.



Courtesy of Beaumont Iron Works Company.

Fig. 10—Constructional features of a Beaumont No. 11 draw-works bearing assembly, provided with a "non-over-load" type of grease lubrication which prevents "crowding" the bearings and waste of lubricant.

ture of this film or to its being squeezed out to excess.

Bending or articulation imposes wear not only on the actual points of contact between the teeth and chain but also on the link pin bearings. Correct chain design eliminates this tendency by confining the necessary rubbing and rolling to the joints themselves. It is, however, almost impossible to eliminate external wear. Here again, effective lubrication becomes a factor. Penetration is, of course, influenced by the amount of clearance existing between the component parts of the chain. If these clearances are low the lubricant should be of lighter body. This latter will also be an adjunct in cold starting.

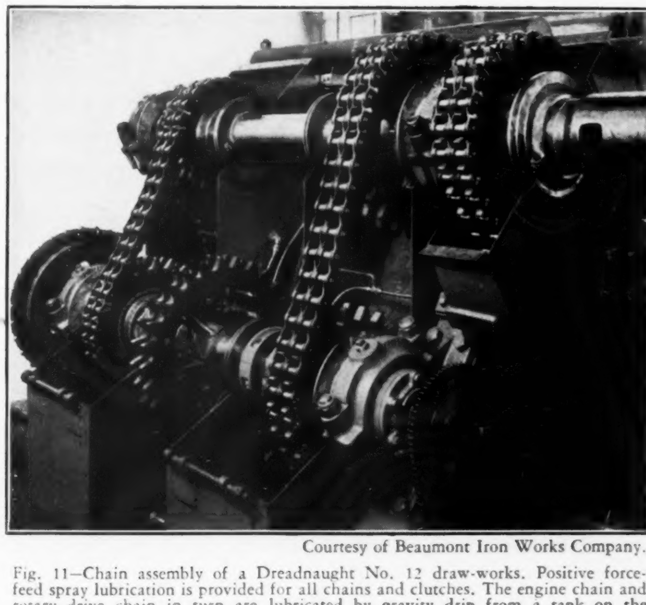
Straight Mineral Oils are Best

To meet these conditions most effectively in average oil-field operation, it has been found best to use straight mineral lubricants. Where gear and chain assemblies are properly housed, the minimum viscosity range should normally be around 500 seconds Saybolt Universal at 100° Fahr. According to temperature conditions this may range up to perhaps 900 seconds. Under exposed conditions, however, it will be necessary to go considerably higher in the viscosity range. Under some conditions the automotive type of straight mineral gear lubricant will perform satisfactorily. Under others, involving perhaps higher temperatures with normal clearances or heavy duty link mechanisms, it may be advisable to go as high as 1000 seconds Saybolt Universal at 210° Fahr.

Relubrication and Cleaning

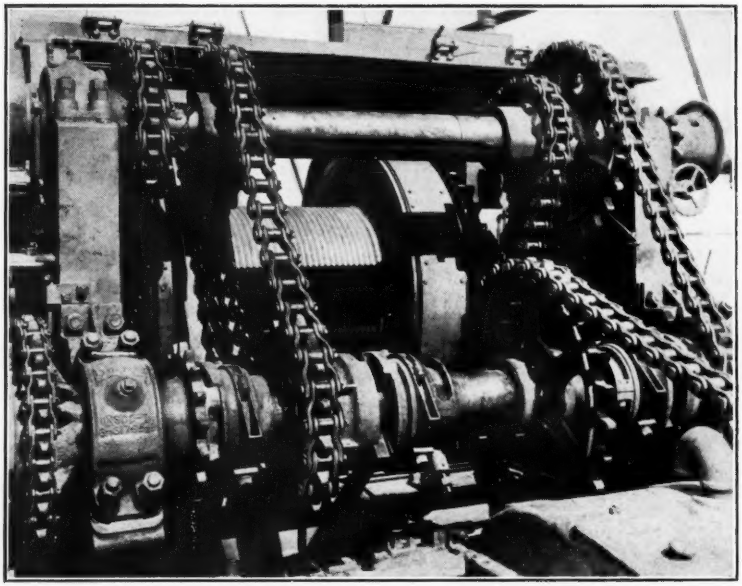
The operating conditions will influence the frequency at which oil-field driving chains should be cleaned and relubricated. Under conditions where contamination by dust and dirt may not be extreme it will perhaps only be necessary to renew lubricant on exposed chains at weekly to semi-monthly intervals. Perhaps every three months it may be advisable to wash the chain surfaces and link mechanisms as thoroughly as possible with kerosine. Chain manufacturers recommend entire removal of the chain from the assembly and complete immersion in a bath of kerosine. This is especially advisable with silent chains by reason of their intricate link mechanism.

The heavy duty exposed roller type of chain requires careful attention wherever it may be exposed to the weather and the possibility of contact with considerable dust and dirt, as in the southwest under dust storm conditions. The cost of chain replacement may become a serious item if lubrication is neglected. Chains of this type, therefore, should be



Courtesy of Beaumont Iron Works Company.

Fig. 11—Chain assembly of a Dreadnaught No. 12 draw-works. Positive force-feed spray lubrication is provided for all chains and clutches. The engine chain and rotary drive chain in turn are lubricated by gravity drip from a tank on the head board.



Courtesy of Link-Belt Company.

Fig. 12—Showing a set of Link-Belt 3-bar Hyper chains on an oil field draw-works.

given very careful consideration for any chain failure in connection with the draw works would cause work stoppage.

PUMPING ESSENTIAL TO WET DRILLING

As rotary drilling is wet drilling, constant circulation of a watery-mud or slush must be maintained. Heavy duty pumps are therefore required. The primary function of rotary mud is to serve as the carrying medium to remove the cuttings and sand which are developed during drilling and which would otherwise clog the drill.

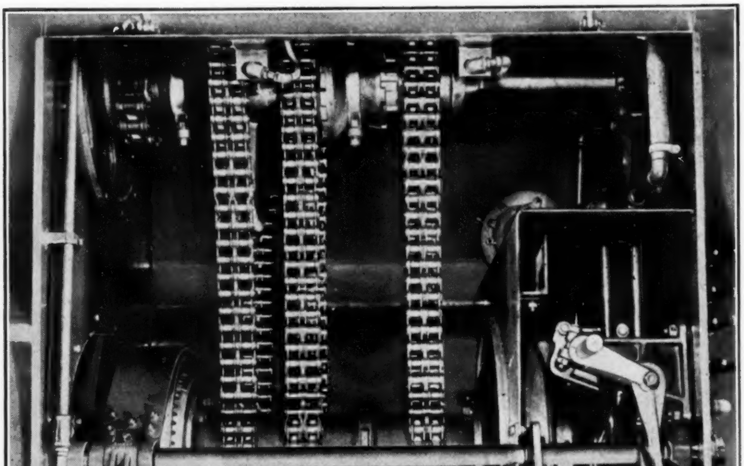
Rotary mud is preferred to water due to the increased body and greater ease with which cuttings are held in suspension. Later, however, this very property may hinder proper separation and reclaiming of the mud for re-usage. It is of further advantage to remove sand, shale and rock particles in order to protect the working elements of the pumping system. An excess of abrasive matter would wear the pump liners and affect the valve motions.

The shaking screen has been widely adopted, therefore, for cleaning rotary mud.

Pump Design

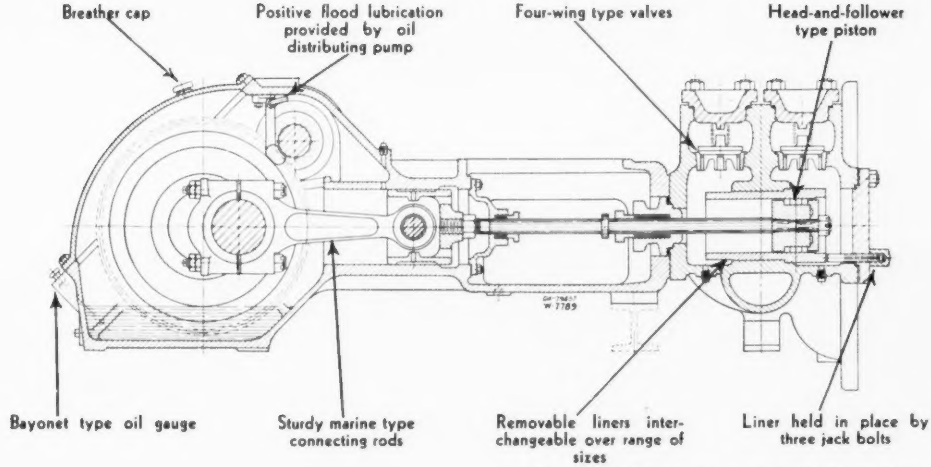
The reciprocating duplex piston or poppet valve type pump is best suited to the handling of the average mud or slush employed in rotary drilling. High pressures are usually necessary, ranging from 750 to 1200 pounds per square inch, although the modern heavy duty slush pump will be capable of functioning up to 2500 pounds safe working load. The drive will depend upon the design, and type of power take-off. Common practice is to use direct connected steam pumps although many chain and sprocket drives are used on steam rigs to drive the gear reduction or power pumps.

The driving gear or power end of an oil-field pump must be protected. Accordingly, these mechanisms are housed against entry of slush, mud or other foreign matter in a suitable base casting, covered with a sheet metal hood. By gasketing the joints, and adding the further provision of a mud



Courtesy of Emsco Derrick & Equipment Company.

Fig. 13—An Emsco G-42 jack shaft and line shaft assembly on a drilling power rig. Flood lubrication is an important feature of this arrangement, likewise oil-tight and dust-proof compartments.



Courtesy of Worthington Pump & Machinery Corp.

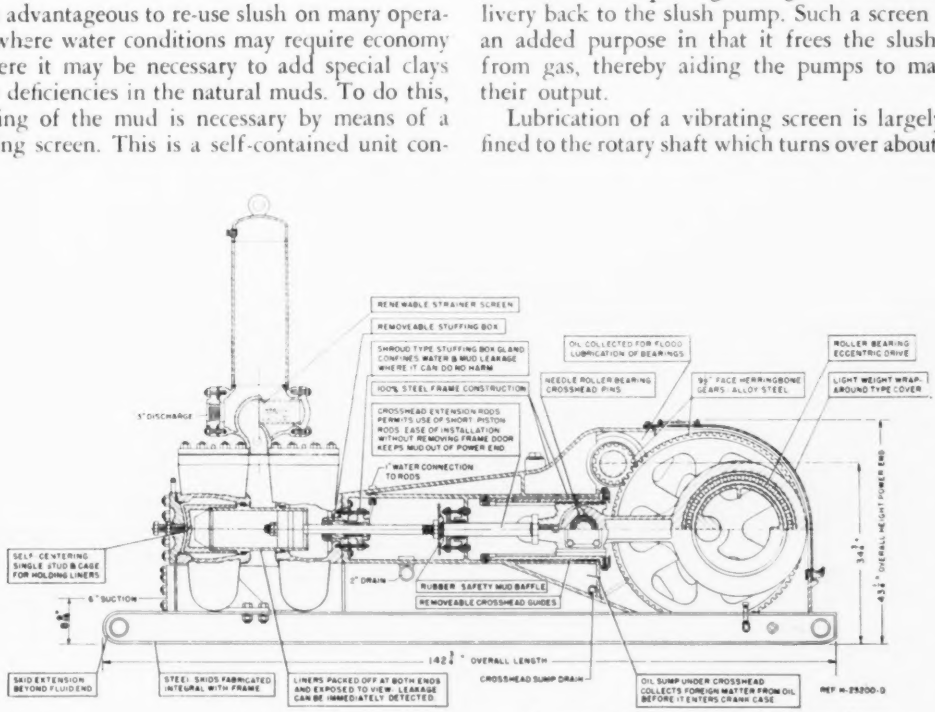
Fig. 14—Section of a Worthington horizontal duplex power pump for oil-field service. Here again positive flood lubrication is a feature.

stop head next to the fluid end stuffing box to divert any leakage of mud or slush fluid past the stuffing box into the sump below, contamination of lubricants is effectively prevented. An oil stop head also prevents loss of lubricant along the piston rod.

Cleaning Rotary Mud or Slush

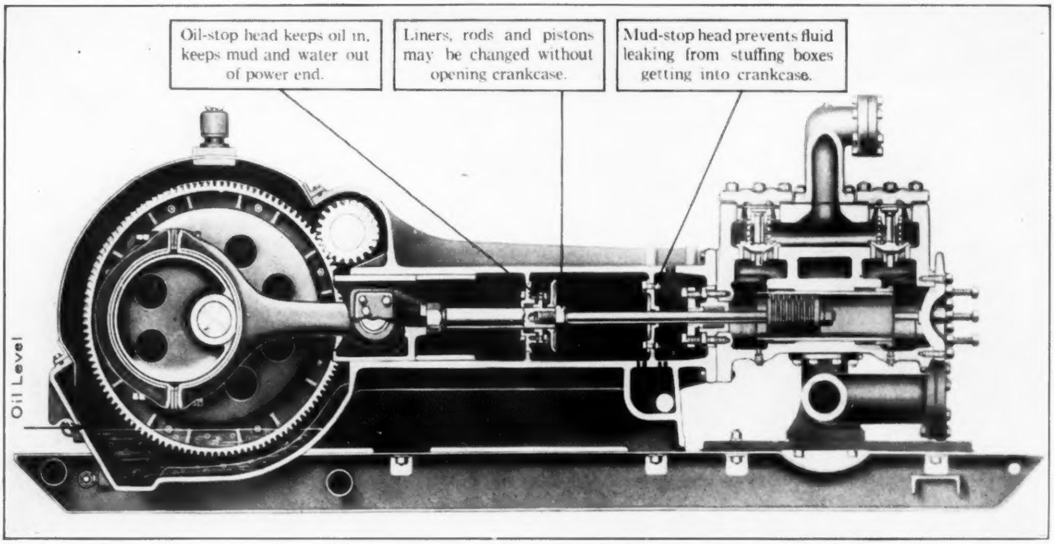
It is advantageous to re-use slush on many operations where water conditions may require economy or where it may be necessary to add special clays due to deficiencies in the natural muds. To do this, screening of the mud is necessary by means of a vibrating screen. This is a self-contained unit consisting of a screen deck carried in a suitable box. Vibration is brought about by a rotating shaft, an arrangement of out-of-balance pulleys and a spring assembly. The screen is normally set in an inclined position to allow the mud or slush to flow over the screen deck, which removes sand, shale and rock particles, discharging same into a reject pit, the fluid meanwhile passing through the screen for delivery back to the slush pump. Such a screen serves an added purpose in that it frees the slush fluid from gas, thereby aiding the pumps to maintain their output.

Lubrication of a vibrating screen is largely confined to the rotary shaft which turns over about 1800



Courtesy of Emsco Derrick & Equipment Company.

Fig. 15—An Emsco slush pump. Note particularly the design which provides for flood lubrication and the safety mud baffle.



Courtesy of Gardner-Denver Company.
Fig. 16—A Gardner-Denver slush pump showing the means provided to prevent entry of mud into the lubricating system.

r.p.m. This shaft is normally mounted in sealed anti-friction bearings provided with means for pressure grease lubrication.

These bearings are pre-lubricated before leaving the factory. Later in service re-lubrication about once a month is advisable. Care should be exercised to see that they are not over-lubricated; about two ounces only is necessary for the conventional size of bearing used on the screen shown in Figure 17. A slight excess of grease is better than not enough even though the bearing may overheat slightly until the excess is discharged. The design of these bearings insures freedom from contaminating foreign matter if the grease is kept free from grit or dirt.

Courtesy of Link-Belt Company.
Fig. 17—A Link-Belt shaker screen for cleaning rotary mud or slush.

CONCLUSION

This review of the machinery essential to oil-field production of crude petroleum is presented to emphasize how important it is to maintain effective lubrication in the industry which produces lubricants. With petroleum as with any other war material there is a definite so-called production line. From the commencement of drilling until the finished petroleum products are run from the refinery to the various means of transportation, the sequence of operations must not be interrupted. Huge volumes of material are involved, paralleled only by the iron, steel and coal industries.

It is with pride that we, in the petroleum industry, review our efforts to keep the mechanical details of our own house in order.

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(Continued from Inside Front Cover)

TEXACO LUBRICANTS IN THE OIL FIELDS

POWER EQUIPMENT

STEAM ENGINES

CYLINDER LUBRICATION—100 to 150 lb. Steam	Texaco Pinnacle Cylinder Oil
150 to 250 lb. Steam	Texaco Leader Valve Oil
250 to 350 lb. Steam	Texaco 650 T Cylinder Oil
Superheated Steam	Texaco 650 T Cylinder Oil
ENGINE BEARINGS—Enclosed Systems	Texaco Regal Oil B or C, or Texaco Aleph or Altair Oils
Anti-friction Type	Texaco Ursa Oil, or Texaco Motor Oil SAE 40
Plain Bearings, Hand or Sight-feed Oiled	Texaco Aleph or Altair Oils

DIESEL AND OTHER OIL ENGINES

SLOW SPEED—Cylinders	Texaco Ursa or Ursa Oil X**
Bearings	Texaco Algol or Ursa Oils, or Texaco Regal Oil C or E
HIGH SPEED	Texaco Ursa Oil X**

(For specific recommendations refer "Texaco Diesel Lubrication Guide")

GAS ENGINES

SLOW SPEED—Cylinders	Texaco Ursa or Ursa P Oils
Bearings	Texaco Ursa or Ursa P Oils, or Texaco Regal Oil C or E
HIGH SPEED	Texaco Ursa Oil X**

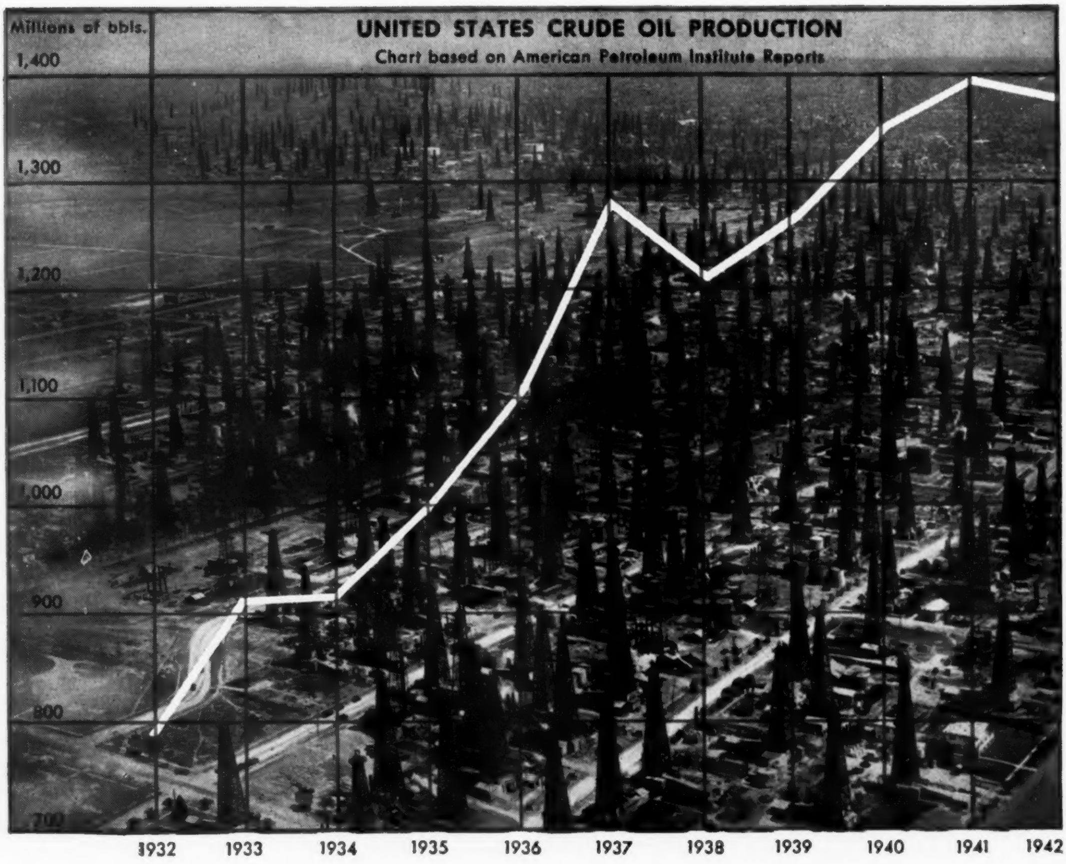
(For specific recommendations refer LUBRICATION—October, 1941)

ELECTRIC MOTORS

RING OILED BEARINGS	Texaco Cetus or Alcaid Oils, or Texaco Canopus Oil C or D
BALL OR ROLLER BEARINGS—Above 2" Dia.	Texaco Marfak No. 1, or Texaco Starfak Grease M or H
Below 2" Dia.	Texaco Starfak Grease L or M

SLUSH OR MUD PUMPS

STEAM CYLINDERS	Use same lubricant as on steam engines
CRANKCASE	
SLEEVE TYPE BEARINGS AND FLOOD LUBRICATED GEARS	
Normal Temperatures	Texaco Thuban 90
Cold Weather Service	Texaco Thuban 80, or Texaco Motor Oil SAE 20
ROLLER BEARINGS	Texaco Marfak or Starfak Grease M or H
EXTREME PRESSURE SERVICE	
Normal Temperatures	Texaco Hypoid Thuban 140, or Texaco 650 T Cylinder Oil
Cold Weather Service	Texaco Hypoid Thuban 90, or Texaco Meropa Lubricant 3
WORM DRIVES	Texaco Thuban 140, or Texaco 650 T Cylinder Oil



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